PATENT ABSTRACTS OF JAPAN

(11)Publication number : **06-176784**
(43)Date of publication of application : **24.06.1994**

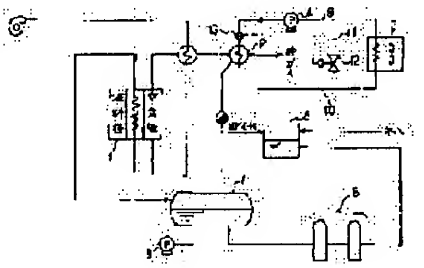
(51)Int.CI. **H01M 8/04**

(21)Application number : **04-322044**
(22)Date of filing : **01.12.1992**

(71)Applicant : **MITSUBISHI ELECTRIC CORP**
(72)Inventor : **TAKEDA ATSUSHI**

(54) CONDENSED WATER RECOVERY DEVICE OF FUEL CELL

(57)Abstract:
PURPOSE: To keep the life of an ion exchange treaatment device long by keeping the amount of heat exchange by means of a condensation heat exchanger at a fixed level regardless of change in air temperature, and whereby not increasing the amount of recovered water and the amount of phosphoric acid even when the air temperature is low, in the condensed water recovery device of a fuel cell, in which the exhausted air of the fuel cell is cooled by cooling water in the condensation heat exchanger, for recovery, and phosphoric acid is removed by the ion exchange treatment device, and the water is supplied to cooling water for fuel cell.
CONSTITUTION: The flow of cooling water fed to a condensation heat exchanger 2 by a fixed flow pump 4 is kept at a fixed level, and a flow control valve 12 provided on a bypass piping 11 communicated to cooling water piping 9 in which cooling water is flowed to the condensation heat exchanger 2, and to a hot water piping 10 in which hot water from the condensation heat exchanger 2 is flowed, is controlled by a water temperature control means 13, according to the temperature of the cooling water fed to the condensation heat exchanger 2. The temperature of the cooling water is kept constant by controlling the flow of the hot water to be mixed with the cooling water, and the amount of heat exchange at the condensation heat exchanger 2 is kept constant.



LEGAL STATUS

[Date of request for examination]	09.10.1995
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	2860213
[Date of registration]	04.12.1998
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] At the heat-of-condensation exchanger which cools with cooling water, is made to condense the exhaust from the air pole of a fuel cell, and obtains recycled water It has the cooling water circuit which changes into cooling water the warm water produced by the heat exchange in this heat-of-condensation exchanger by the cooling means, and is supplied to the above-mentioned heat-of-condensation exchanger. In the water-of-condensation recovery system of a fuel cell which purifies through the ion-exchange-treatment equipment which purifies the recycled water obtained from the above-mentioned heat-of-condensation exchanger, and obtained make up water to a steam separator Bypass piping which supplies the warm water which is open for free passage for warm water piping for which warm water flows to the above-mentioned cooling means from the cooling water piping to which cooling water flows from the above-mentioned cooling means to the above-mentioned heat-of-condensation exchanger, and the above-mentioned heat-of-condensation exchanger, and flows under the above-mentioned warm water piping in the above-mentioned cooling water circuit into the above-mentioned cooling water piping, The water-of-condensation recovery system of the fuel cell characterized by having the water temperature control means which keeps constant the temperature of the flow control valve prepared in this bypass piping, and the cooling water which measures the temperature of the above-mentioned cooling water, controls the above-mentioned flow control valve according to the measured value, and flows to the above-mentioned heat-of-condensation exchanger.
[Claim 2] At the heat-of-condensation exchanger which cools with cooling water, is made to condense the exhaust from the air pole of a fuel cell, and obtains recycled water It has the cooling water circuit which changes into cooling water the warm water produced by the heat exchange in this heat-of-condensation exchanger by the cooling means, and is supplied to the above-mentioned heat-of-condensation exchanger. In the water-of-condensation recovery system of a fuel cell which purifies through the ion-exchange-treatment equipment which purifies the recycled water obtained from the above-mentioned heat-of-condensation exchanger, and obtained make up water to a steam separator A hydrometry means to measure the flow rate of the above-mentioned cooling water in the above-mentioned cooling water circuit, and a water temperature measurement means to measure the temperature of the above-mentioned cooling water, The water-of-condensation recovery system of the fuel cell characterized by having a control-of-flow means to control the flow rate of the cooling water supplied to the above-mentioned heat-of-condensation exchanger that the amount of heat exchanges of the above-mentioned heat-of-condensation exchanger should be made fixed to the thermometry value of cooling water based on the measured value of the above-mentioned hydrometry means and the above-mentioned thermometry means.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the water-of-condensation recovery system of the fuel cell which is made to condense the moisture in the exhaust of a fuel cell, collects and purifies, and is supplied to the cooling water for fuel cells.
[0002]
[Description of the Prior Art] Drawing 5 is a block diagram showing the water-of-condensation recovery system of the conventional fuel cell shown in JP,62-291865,A and JP,2-10664,A. In this drawing, 1 is the fuel cell which has a fuel electrode and an air pole and obtains a direct current power, and it discharges exhaust from an air pole while it makes the reforming gas obtained by the reaction of a propellant and the raw material steam for reforming with the reforming vessel not to illustrate react with air by the fuel electrode and obtains a direct current power.
[0003] The heat-of-condensation exchanger which cools by the heat exchange with cooling water, and 2 makes condense the moisture in the exhaust from the air pole of a fuel cell 1, and obtains a water of condensation, the cooling tower which cools the cooling water from which 3 became warm water by the heat exchange in the heat-of-condensation exchanger 2, and 4 are constant flow rate pumps made to circulate through cooling water through the heat-of-condensation exchanger 1 and the cooling tower 3.
[0004] The deaeration tub which 5 deaerates gas constituents, such as recycled water which collected the water of condensations obtained by the heat-of-condensation exchanger 2, and carbon dioxide gas in the city water from the exterior, and obtains degassed water, and 6 are ion-exchange-treatment equipments which purify the degassed water obtained by the deaeration tub 5 by ion exchange resin, and obtain a pure water.
[0005] While 7 obtains the raw material steam for reforming required for the reaction in the cooling water and the reforming machine which separate the steam and water which are produced by cooling of a fuel cell 7, and cool a fuel cell 7, the steam separator to which the pure water obtained with the ion-exchange-treatment equipment 6 as make up water of the cooling water of a fuel cell 7 is supplied, and 8 are pumps for fuel cell cooling water which make a fuel cell 1 circulate through the cooling water for fuel cells obtained by the steam separator 7.
[0006] In addition, the cooling water piping to which, as for 9, cooling water flows from the cooling tower 3 to the heat-of-condensation exchanger 2, and 10 are warm water piping for which the cooling water which turned into warm water by the heat exchange in the heat-of-condensation exchanger 2 flows from the heat-of-condensation exchanger 2 to a cooling tower 3.
[0007] Next, an operation of a configuration of having mentioned above is explained. It is cooled by the heat exchange with the cooling water which is introduced into the heat-of-condensation exchanger 2, and is supplied to the heat-of-condensation exchanger 2 with the constant flow rate pump 4, and the exhaust from the air pole of a fuel cell 1 is condensed including the phosphoric acid in which the moisture in exhaust dispersed from the fuel cell electrolyte, and is obtained as a water of condensation.
[0008] The recycled water which collected these water of condensations is introduced into the deaeration tub 5, is deaerated, turns into degassed water, and is introduced into the ion-exchange-treatment equipment 6. The ion-exchange-treatment equipment 6 removes the phosphoric-acid ion in degassed water by ion exchange resin, uses degassed water as a pure water, and supplies it to a steam separator 7. Thereby, the cooling water of a fuel cell 7 consumed as steam for reforming by the steam separator 7 is supplied.
[0009] Moreover, when supply guesses run short, a city water is supplied to the deaeration tub 5, and the insufficiency of recycled water is compensated only with recycled water.
[0010] On the other hand, the cooling water supplied to the heat-of-condensation exchanger 2 turns into warm water by the heat exchange, and is introduced into a cooling tower 3. The warm water cooled in the cooling tower 3 turns into cold water, and is again supplied to the heat-of-condensation exchanger 2.
[0011]
[Problem(s) to be Solved by the Invention] In the water-of-condensation recovery system of the conventional fuel cell, since the temperature of the cooling water of the heat-of-condensation exchanger 2 changes in connection with change of the atmospheric temperature for every season and the amount of heat exchanges in the heat-of-condensation exchanger 2 changes, the amount of phosphoric acids which the amount of recycled water from the heat-of-condensation exchanger 2 changes, and

is removed with ion-exchange-treatment equipment changes. That is, since the amount of heat exchanges of the heat-of-condensation exchanger 2 increases and the amount of recycled water increases when the temperature of cooling water, such as winter, is low, the amount of phosphoric acids removed with the ion-exchange-treatment equipment 7 increases.

[0012] Although the phosphoric acid in recycled water was removed from recycled water when the phosphoric-acid ion which is an anion neutralized with the cation of the ion exchange resin in the ion-exchange-resin equipment 7, when it had many amounts of phosphoric acids which atmospheric temperature should remove low, the cation of ion exchange resin required for saturation of phosphoric-acid ion of it was lost immediately, and it had the trouble where the life of ion exchange resin became short.

[0013] This invention was made in order to solve such a trouble, and even when atmospheric temperature, such as winter, is low, it aims at obtaining the water-of-condensation recovery system of the fuel cell which can keep the life of ion exchange resin long.

[0014]

[Means for Solving the Problem] The water-of-condensation recovery system of the fuel cell concerning the claim 1 of this invention At the heat-of-condensation exchanger which cools with cooling water, is made to condense the exhaust from the air pole of a fuel cell, and obtains recycled water It has the cooling water circuit which changes into cooling water the warm water produced by the heat exchange in this heat-of-condensation exchanger by the cooling means, and is supplied to the above-mentioned heat-of-condensation exchanger. In the water-of-condensation recovery system of a fuel cell which purifies through the ion-exchange-treatment equipment which purifies the recycled water obtained from the above-mentioned heat-of-condensation exchanger, and obtained make up water to a steam separator Bypass piping which supplies the warm water which is open for free passage for warm water piping for which warm water flows to the above-mentioned cooling means from the cooling water piping to which cooling water flows from the above-mentioned cooling means to the above-mentioned heat-of-condensation exchanger, and the above-mentioned heat-of-condensation exchanger, and flows under the above-mentioned warm water piping in the above-mentioned cooling water circuit into the above-mentioned cooling water piping, It has the water temperature control means which keeps constant the temperature of the flow control valve prepared in this bypass piping, and the cooling water which measures the temperature of the above-mentioned cooling water, controls the above-mentioned flow control valve according to the measured value, and flows to the above-mentioned heat-of-condensation exchanger.

[0015] Moreover, the water-of-condensation recovery system of the fuel cell concerning the claim 2 of this invention At the heat-of-condensation exchanger which cools with cooling water, is made to condense the exhaust from the air pole of a fuel cell, and obtains recycled water It has the cooling water circuit which changes into cooling water the warm water produced by the heat exchange in this heat-of-condensation exchanger by the cooling means, and is supplied to the above-mentioned heat-of-condensation exchanger. In the water-of-condensation recovery system of a fuel cell which purifies through the ion-exchange-treatment equipment which purifies the recycled water obtained from the above-mentioned heat-of-condensation exchanger, and obtained make up water to a steam separator A hydrometry means to measure the flow rate of the above-mentioned cooling water in the above-mentioned cooling water circuit, and a water temperature measurement means to measure the temperature of the above-mentioned cooling water, It has a control-of-flow means to control the flow rate of the cooling water supplied to the above-mentioned heat-of-condensation exchanger that the amount of heat exchanges of the above-mentioned heat-of-condensation exchanger should be made fixed to the thermometry value of cooling water based on the measured value of the above-mentioned hydrometry means and the above-mentioned thermometry means.

[0016]

[Function] In the water-of-condensation recovery system of the fuel cell concerning the claim 1 of this invention, the temperature of the cooling water which flows at a heat-of-condensation exchanger is kept constant by controlling the flow rate of the warm water which controls the flow control valve which measures the temperature of the cooling water supplied to a heat-of-condensation exchanger, and was prepared in bypass piping by the water temperature control means according to measured value, and is mixed with cooling water. Thereby, the amount of heat exchanges in a heat-of-condensation exchanger is fixed, and the amount of recycled water of the heat-of-condensation exchanger purified with ion-exchange-treatment equipment is fixed.

[0017] Moreover, the water-of-condensation recovery system of the fuel cell concerning the claim 2 of this invention controls the flow rate of the cooling water supplied to a heat-of-condensation exchanger by the control-of-flow means according to the thermometry value of cooling water based on the measured value of a hydrometry means and a thermometry means so that the amount of heat exchanges of a heat-of-condensation exchanger may become fixed. Thereby, the amount of recycled water of the heat-of-condensation exchanger purified with ion-exchange-treatment equipment is fixed.

[0008]

[Example] Hereafter, many examples of this invention are explained about drawing.

Example 1. view 1 is the block diagram showing the example 1 of this invention. In this drawing, 1-10 are the same configurations as drawing 5 , and 11 is bypass piping which feeds back the warm water which flows under the warm water piping 10 into a cooling water piping 9, and is mixed in cooling water.

[0019] The flow control valve by which 10 was prepared in the bypass piping 11, and 13 are water temperature control

meanses to measure the temperature of the cooling water which is prepared in the cooling water piping 9 between the constant flow rate pump 4 and the heat-of-condensation exchanger 2, and is supplied to the heat-of-condensation exchanger 2, and to control a flow control valve 12 according to measured value.

[0020] Next, an operation of a configuration of having mentioned above is explained. The water temperature control means 13 measures the temperature of the cooling water supplied to the heat-of-condensation exchanger 2, and it controls the flow rate of the warm water which controls a flow control valve 12 and is mixed with the cooling water in the cooling piping 9 through the bypass piping 11 so that measured value always becomes fixed.

[0021] Moreover, cooling water is supplied to the heat-of-condensation exchanger 2 with constant flow with the constant flow rate pump 4 while it is controlled by constant temperature in this way.

[0022] Therefore, since the flow rate and temperature of cooling water which are supplied to the heat-of-condensation exchanger 2 are always kept constant, the amount of heat exchanges in the heat-of-condensation exchanger 2 becomes always fixed. Therefore, since the amount of recycled water collected from a heat exchanger 2 irrespective of atmospheric temperature is fixed, the amount of phosphoric acids removed with the ion-exchange-treatment equipment 6 is fixed.

[0023] Example 2. view 2 is the block diagram of the example 2 of this invention. In this example 2, centrifugal type pump 4A is prepared in a cooling water piping 9, and, thereby, cooling water is circulated. Moreover, the flow rate of the cooling water which forms a flow control valve 12 near the vegetation opening of centrifugal type pump 4a, and forms the hydrometry means 14 in the outlet of a flow control valve 12, and is supplied to the heat-of-condensation exchanger 2 through a flow control valve 12 by this is measured.

[0024] Moreover, while thermometry means 13A which measures the temperature of cooling water 2 is prepared near the circulating-water-flow inlet of the heat-of-condensation exchanger 2, the rate controller 15 which controls the flow rate which controls the opening of a flow control valve 12 based on the measured value and the measured value of the hydrometry means 14, and is supplied to the heat-of-condensation exchanger 2 is formed. Other configurations are the same as that of drawing 1

.

[0025] Next, an operation of a configuration of having mentioned above is explained. Amount H of heat exchanges of the heat-of-condensation exchanger 2 is H=KAdeltaTm. -- It is expressed with (1) and decided by generalization heat transfer coefficient K decided according to the quality of the material of the heat-of-condensation exchanger 2, heating-surface A decided with the configuration of the heat-of-condensation exchanger 2, and log-mean-temperature-difference deltaTm by the side of **** in the heat-of-condensation exchanger 2, and heat-receiving (exhaust) (cooling water side). In addition, log-mean-temperature-difference deltaTm is expressed as deltaTm= {(c-d)- (a-b)}/ln {(c-d)/(a-b)} using cooling water temperature d after temperature a of the exhaust after temperature c of the exhaust in front of a heat exchange, and a heat exchange and cooling water temperature b in front of a heat exchange, and a heat exchange.

[0026] Moreover, amount Q of circulating water flows is Q=H/(b-a). -- It is expressed with (2).

[0027] Since generalization heat transfer coefficient K and heating-surface A are regularity since it is peculiar to the heat-of-condensation exchanger 2, and temperature a of the exhaust in front of a heat exchange and temperature c of the exhaust after a heat exchange were beforehand decided by the above-mentioned (1) formula as process conditions, amount H of heat exchanges is dependent on difference b-d of cooling water temperature b in front of a heat exchange, and cooling water temperature d after a heat exchange.

[0028] Therefore, since cooling water temperature d after a heat exchange was decided when measurement of water temperature measurement means 13A showed cooling water temperature b in front of a heat exchange when amount H of heat exchanges was set constant, when amount H of heat exchanges of the heat-of-condensation exchanger 2 is set constant by (2) formulas from (1) formula, circulating water flow Q is dependent on the cooling water temperature measured by cooling water temperature b in front of a heat exchange, i.e., water temperature measurement means 13A.

[0029] Therefore, amount Q of circulating water flows to cooling water temperature b for amount H of heat exchanges of the heat-of-condensation exchanger 2 becoming fixed comes to be shown in drawing 3 as a solid line, and serves as the property which increases with elevation of cooling water temperature b.

[0030] Then, circulating water flow Q corresponding to cooling water temperature b obtained from the property of drawing 3 is beforehand set as a rate controller 15, and the opening of a flow control valve 12 is controlled so that the circulating water flow measured with the hydrometry means 14 by the rate controller 15 according to the cooling water temperature measured by water temperature measurement means 13A serves as the set point. Thereby, cooling water is supplied to the heat-of-condensation recovery system 2 by the necessary flow rate.

[0031] Thus, in this example 2, since a circulating water flow is controlled according to cooling water temperature and the amount of heat exchanges in the heat-of-condensation exchanger 2 is fixed, irrespective of atmospheric temperature, the amount of recycled water from the heat-of-condensation exchanger 2 is fixed, therefore the amount of phosphoric acids removed with the ion-exchange-treatment equipment 6 is held uniformly.

[0032] Example 3. view 4 is the block diagram showing the example 3 of this invention. Having formed this example 3 in the bypass piping 11 which opens a flow control valve 12 for free passage for a cooling water piping 9 and the warm water piping 10 differs from drawing 2 . Other configurations are the same as that of drawing 2 .

[0033] Next, an operation is explained. In quest of the circulating water flow corresponding to the cooling water temperature measured by water temperature measurement means 13A, it is set as a rate controller 15 with the property of drawing 3 . A rate controller 15 controls the opening of a flow control valve 12 so that the amount of circulating water flows measured by

the hydrometry means 14 becomes the set point according to the cooling water temperature measured by water temperature measurement means 13A, and it controls the circulating water flow which flows from a cooling water piping 9 to the warm water piping 10.

[0034] Thus, the amount of heat exchanges in the heat-of-condensation exchanger 2 is fixed by controlling indirectly the flow rate of the cooling water supplied to the heat-of-condensation exchanger 2 according to the temperature of the cooling water which flows the heat-of-condensation exchanger 2. Since the amount of recycled water obtained from the heat-of-condensation exchanger 2 irrespective of atmospheric temperature becomes fixed by this, the amount of phosphoric acids removed with the ion-exchange-treatment equipment 6 becomes fixed.

[0035] Although the opening of a flow control valve 12 is controlled by the rate controller 15, you may be made to control the rotational frequency of centrifugal type pump 4A by the example 4. above-mentioned example 2, without using a flow control valve 12. This controls the rotational frequency of the motor which drives for example, centrifugal type pump 4A by the rate controller 15, or is slippery between a motor and centrifugal type pump 4A, forms a joint, carries out controlling this by the rate controller 15 etc., and is attained.

[0036] Thus, power expense will be reduced if the rotational frequency of the centrifugal type pump 4 is controlled.

[0037]

[Effect of the Invention] As mentioned above, the water-of-condensation recovery system of the fuel cell concerning the claim 1 of this invention According to the temperature of the cooling water supplied to a heat-of-condensation exchanger, the flow control valve prepared in bypass piping which is open for free passage for warm water piping for which the warm water from a cooling water piping and a heat-of-condensation exchanger with which cooling water flows to a heat-of-condensation exchanger flows is controlled. Even if atmospheric temperature changes by having kept the temperature of cooling water constant by controlling the flow rate of the warm water mixed with cooling water, since the amount of heat exchanges in a heat-of-condensation exchanger is fixed, by maintaining the temperature of cooling water uniformly Since the amount of phosphoric acids which the amount of recycled water of the heat-of-condensation exchanger purified with ion-exchange-treatment equipment does not increase, but is removed does not increase even when atmospheric temperature, such as winter, is low, the effect that the life of the ion exchange resin of ion-exchange-treatment equipment can be kept long is done so.

[0038] Moreover, the water-of-condensation recovery system of the fuel cell concerning the claim 2 of this invention Since the amount of heat exchanges is fixed even if atmospheric temperature changes by having controlled the flow rate of the cooling water supplied to a heat-of-condensation exchanger according to the thermometry value of cooling water so that the amount of heat exchanges of a heat-of-condensation exchanger may become fixed Since the amount of phosphoric acids which the amount of recycled water of the heat-of-condensation exchanger purified with ion-exchange-treatment equipment does not increase, but is removed does not increase even when atmospheric temperature, such as winter, is low, the effect that the life of the ion exchange resin of ion-exchange-treatment equipment can be kept long is done so.

[Translation done.]